International Journal on
"Technical and Physical Problems of Engineering"
(IJTPE)
Published by International Organization of IOTPE

ISSN 2077-3528
IJTPE Journal
www.iotpe.com
ijtpe@iotpe.com

June 2022 | Issue 51 | Volume 14 | Number 2 | Pages 307-313

STUDY OF MOTORCYCLE RIDER SAFETY BEHAVIOR USING STRUCTURAL EQUATION MODELING

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Abstract- The World Health Organization (WHO) publishes those deaths from road traffic accidents are treated as one of the non-communicable diseases with the highest number of deaths. The Directorate General of Highways (2012) reported the number of deaths due to road traffic accidents in 2010 reached 31,234 people with motorcycle riders occupying the highest percentage of 61%. In addition, in the areas of Jakarta, Bogor, Depok, Tangerang and Bekasi (JABODETABEK) motorcycle riders' deaths are above 70% (Directorate General of Highways, 2012). Based on data from the POLRI KORLANTAS (Korps Lalu Lintas Kepolisian Negara Republik Indonesia / Indonesian National Police Traffic Corps), throughout 2018 there were 109,215 traffic accidents on the road. This number increased by 4.69% compared to 2017 with 104,327 incidents (Central Bureau of Statistics, 2019) [10]. There is 73.49% of accidents involve motorcycles. Based on the description that has been described, it can be concluded that the human factor is the biggest factor that causes traffic accidents. Furthermore, safety behavior in driving is one aspect that has involvement in the traffic accident [8]. This research is expected to provide benefits for various parties related to the study of motorcycle riders' safety behavior and its effect on safety behavior [7]. The safety behavior intention variable is the most direct factor influencing the safety behavior of motorcyclists in Jakarta. While the most indirect factor on safety behavior is the attitude of the driver himself [11].

Keywords: Motorcycle Rider, Safety, Structural, Equation Modeling.

1. INTRODUCTION

Road safety according to the Directorate General of Highways in Sujanto and Mulyono (2010), is an effort to overcome accidents that occur on the highway caused by several factors including the driver factor [6]. Thus, road safety is an issue related to traffic culture, both from a technical and non-technical perspective [4]. The aspects considered in road safety will greatly affect the prevention of accidents and reducing the risk of victims [6]. Therefore, road safety is an influential factor in traffic accidents related to the human life [5].

There is 73.49% of accidents involve motorcycles. Furthermore, the areas of Jakarta, Depok, Tangerang and Bekasi are areas with a high number of accidents involving motorbikes [10].

2. SCOPE

In this study, the problems are limited, including:
1. The study population area is Jakarta.
2. Motorcycle riders who are the object of research are ordinary motorcycle riders.
3. The theory used in assessing the safety behavior of motorcyclists is the technology acceptance model, the theory of planned behavior, and the health belief model.

The type of data used is primary data. Primary data obtained from the distribution of the instrument in the form of a questionnaire to the respondents. The purpose of using this questionnaire was to determine self-efficacy, perceived usefulness, perceived ease of use, attitudes, safety behavior intentions, subjective norms, behavioral control, perceived severity, perceived vulnerability, and safety behavior. The type of questionnaire used is closed.

In order to obtain the necessary information and/or data, this research requires an appropriate research approach in order to obtain valid data [13]. The approach used in this research is a quantitative approach. In this study, a quantitative approach was used to measure the level of variables from TAM, TPB and HBM so that a score was obtained which was then processed using statistical data [1].

3. METHODS

The research design in this study is expost-facto. This is because the data obtained is the result of events that have already taken place, and only reveals facts based on symptoms that already exist in the respondent. As stated by Darmadi (2014) [14] which states that exposé-facto research is a study conducted to examine events that have occurred and then trace back to find out the factors that can cause these events. From this understanding, the researcher does not need to give treatment to the variables studied [14].

3.1. Data Analysis Method

3.1.1. Hypothesis Test

Hypothesis testing is with Structural Equation Modeling (SEM) with the help of Software Analysis of Moment Structure (AMOS). SEM is a statistical modeling technique that is cross-sectional, linear and general. This includes factor analysis, path analysis and regression. SEM has characteristics that are analytical techniques to emphasize rather than explain in other words researchers are more likely to use SEM to determine whether a particular model is valid or not rather than use it to find a particular model suitable or not, although SEM analysis often includes elements used to explain (Sarwono, 2010).

3.1.2. Hypothesis Testing and Proofing

The final result of the analysis of structural equations with AMOS 22.00 will be obtained Critical Ratio (C.R.) and also the path coefficient. From these results it will be known the relationship and also the influence between the independent variables on the dependent variable.

3.2. Research Variables

3.2.1. Variable

This study will use 3 types of variables, namely independent variables, dependent variables and intervening variables. These variables are as follows [7]:

1. Independent variables are variables that affect and cause changes or emergence of the dependent variable. In this study, the independent variables were self-efficacy, perceived severity, perceived vulnerability, subjective norms, and behavioral control.
2. The dependent variable is a variable that is influenced by the independent variable. In this study, the dependent variable is the safety behavior of motorcyclists.
3. The intervening variable is a variable that theoretically affects the relationship between the independent variable and the dependent variable. In this study, the intervening variables were perceived usefulness, perceived ease of use, attitudes, and intentions of safe behavior.

3.2.2. Variable Operational Definition

The operational definition of a variable is an element of research that provides an overview of how to measure a variable (Adi, 2019). The operational definitions of variables in this study are presented below [1]:

- Self-efficacy (EFD): Individual beliefs in initiating and maintaining safety behavior changes in driving.
- Perceived usefulness (KGD): Individual perception of safety equipment used in driving.
- Perceived ease of use (KPG): Individual perception of the ease of using safety equipment in driving
- Attitude (SKP): Attitudes are classified into three components, namely, cognitive, affective, and conative.

The cognitive component relates to individual beliefs about everything, either negative or positive about driving attitudes.

- Subjective norm (NRS): The component used is a normative belief in safety behavior in driving with the motivation to follow that behavior.
- Behavior control (KTP): Individual perceptions of the degree of ease and difficulty of behaving safely in driving and the control they have in carrying out these behaviors.
- Happy Behavior Intention (IPS): Internal declaration of motorcyclists in carrying out safety behavior in driving.
- The severity felt (KPD): Severity perception includes evaluating the consequences of an undesirable event when driving.
- Perceived vulnerability (KRD): Perceived vulnerability which measures subjective perceptions of the risk of driving.
- Safety Behavior (PKS): Safety behaviors in riding a motorcycle.

3.3. Population and Research Sample

Sugiyono Adi (2019), explains that the population is a general area and consists of objects or subjects that have certain qualities and characteristics determined by the researcher [29]. The population in this study were all motorcycle riders in the Jakarta area, the sample used was 5 times the number of questions and used a random sampling technique [2].

3.3.1. Types and Sources of Data

The type of data used is primary data. Primary data obtained from the distribution of the instrument in the form of a questionnaire to the respondents. The purpose of using this questionnaire was to determine self-efficacy, perceived usefulness, perceived ease of use, attitudes, safety behavior intentions, subjective norms, behavioral control, perceived severity, perceived vulnerability, and safety behavior [5]. The type of questionnaire used is closed.

3.3.2. Data Collection Techniques

According to Creswell (2012) data collection methods are techniques or methods that can be used by researchers to collect data [28]. Data collection techniques were obtained with the help of research instruments. Sugiyono (2014) explains that the research instrument is a tool used to measure the observed natural and social phenomena [29]. Instruments in quantitative research can be in the form of tests, interview guidelines, observation guidelines and questionnaires (Sugiyono, 2014). Referring to Sugiyono's opinion, this research used a questionnaire instrument in the form of a questionnaire [29]. The filling technique used is the Likert scale by referring to the findings of Retnawati (2015), which states that the Likert scale is more accurate for measuring Self-Regulated Learning (SRL) compared to multiple choice. SRL is the ability to become an active participant in metacognition, motivation and behavior (B.J. Zimmerman in Mukhid, 2008) [25].

Furthermore, the use of responses in the Likert scale is used in the middle category by referring to Kulas et al. (2008), who recommends an assessment of developing a questionnaire to include a middle alternative.

The recommended number of Likert scale response points is 7 response points because it is preferred by respondents and also has quite good criteria of validity, reliability, discrimination power, and stability (Budiaji, 2013). Referring to the findings of Kulas et al. (2008) and Budiaji (2013), the Likert scale used in this study is the Likert scale with 7 response points. The validity and reliability tests will be carried out using the Confirmatory Factor Analysis method with the help of the AMOS 22.00 software.

4. RESULTS AND DISCUSSIONS

4.1. Characteristics of Respondents

Based on the 230 returned questionnaires, the distribution of respondents' characteristics including gender, age, marital status, education level, domicile, income level, SIM C ownership status, and the number of accidents experienced in the last 1 year are presented in Figures 1, 2 and 3, respectively [30].

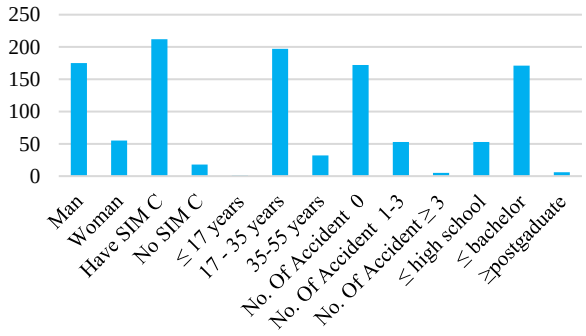

Figure 1. Characteristics of respondents in Jakarta

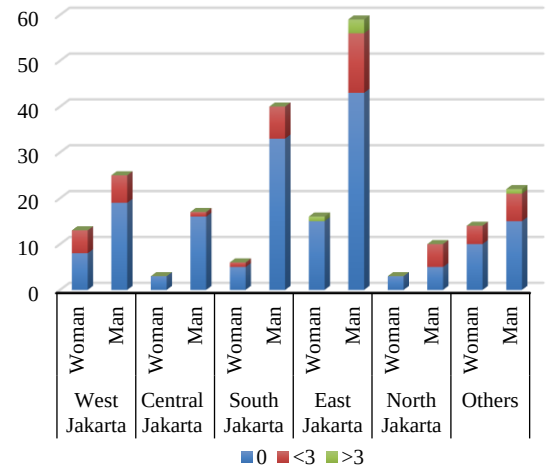

Figure 2. Characteristics of respondents no. of accident

4.2. Discussions

4.2.1. Statistical Inferential Analysis with SEM Analysis

SEM analysis in this study used two stages. The first stage is the measurement of variables using the CFA (Confirmatory Factor Analysis) technique which produces exogenous constructs and endogenous constructs that are fit so that they can be accepted. The second stage is testing the full structure of the SEM model [16].

The SEM analysis of each of these stages is as follows:
1. Confirmatory Factor Analysis (CFA); The exogenous construct in this study consisted of 5 variables studied, including (1) perceived self-efficacy, (2) perceived severity, (3) perceived vulnerability, (4) subjective norms, and (5) perceive behavioral control. The results of the CFA test of this exogenous construct using MOS 22.00 are presented in Figures 4 and 5 as follows.
2. Complete Structural Model Measurement; (Figure 6).

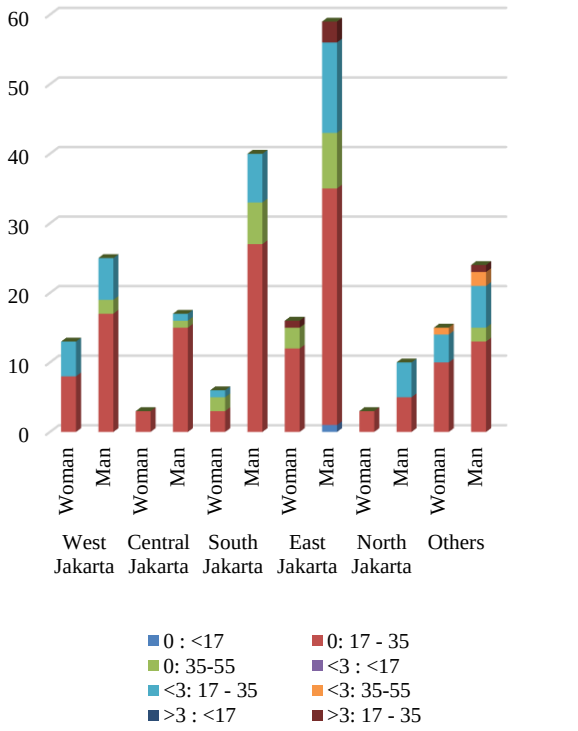

Figure 3. Characteristics of respondents by age and no. of accident

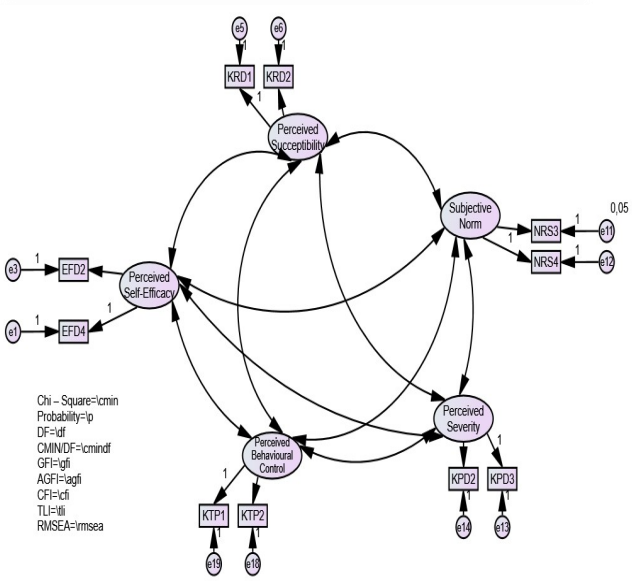

Figure 4. Exogenous construct CFA [30]

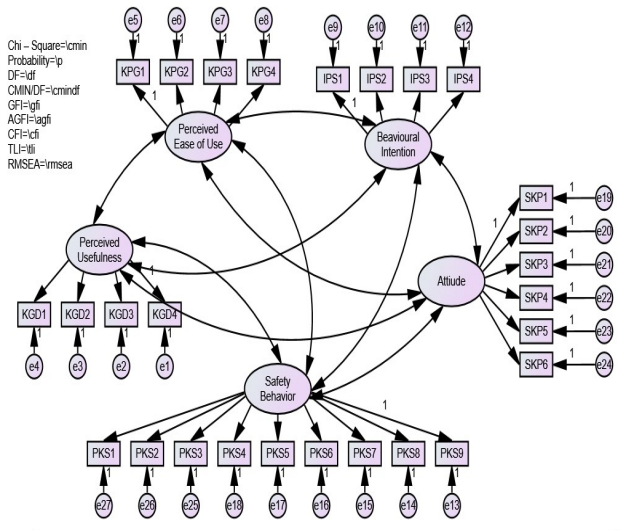

Figure 5. Model 1 CFA endogenous construct [30]

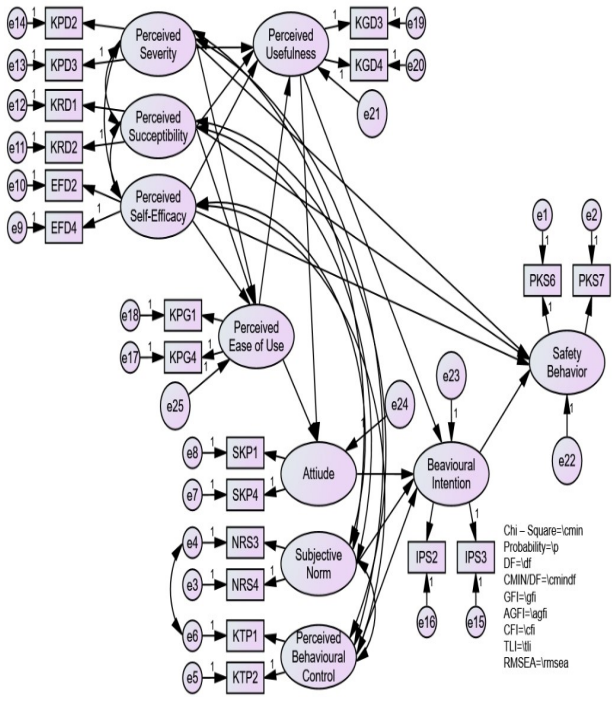

Figure 6. Full SEM model of motorcycle riders' behavior in Jakarta [30]

Based on the full model of the behavior of motorcyclists in Jakarta, the results of the Goodness of Fit Index (GOFI) test analysis on the model can be accepted. This is because the model already meets the required criteria [9]. The GOFI test results are presented in Table 2.

Table 2. Goodness of Fit Index Full Model [30]

No	Goodness of Fit Index	Cut of Value	Result	Criteria
1	X^2 Chi Square Statistic	<170.81	164.471	Good of Fit
2	Significance Probability	≥ 0.05	0.95	Good of Fit
3	CMIN/ DF	≤ 2.00	1.158	Good of Fit
4	GFI	≥ 0.90	0.936	Good of Fit
5	AGFI	≥ 0.90	0.905	Good of Fit
6	TLI	≥ 0.95	0.980	Good of Fit
7	CFI	≥ 0.95	0.985	Good of Fit
8	RMSEA	≤ 0.08	0.026	Good of Fit

4.2.2. Structural Equation Modeling Safety Behavior Modeling for Motorcycle Riders in Jakarta

Based on the structural equation model that is already fit in Figure 6, the variables of this study are represented by each valid indicator based on the calculated value of AMOS 22.00. The indicators that represent the variables studied are as follows:[1]

1. Perceived Severity Variable (KPD)

Question indicators that represent this variable in the overall fit of the model consist of two of them:

KPD2 = I think that driving unsafely is dangerous

KPD3 = I think that driving unsafely is a threat

2. Perceived Vulnerability Variable (KRD)

Question indicators that represent this variable in the overall fit of the model consist of two of them:

KRD1 = I know my life is in danger if I don't demonstrate safe driving behavior

KRD2 = I believe that driving safely will reduce traffic accidents

3. Variable Self-Efficacy (EFD)

Question indicators that represent this variable in the overall fit of the model consist of two of them:

EFD2 = I believe I can adjust the driving speed according to the applicable regulations

EFD4 = I believe I can fully concentrate on driving without doing any activities

4. Perceived Ease of Use Variable (KPG)

Question indicators that represent this variable in the overall fit of the model consist of two of them:

KPG2 = Masks are easy and comfortable to use when riding a motorcycle

KPG4 = Safety equipment is very easy and comfortable to use when riding a motorcycle

5. Perceived Usefulness Variable (KGD)

Question indicators that represent this variable in the overall fit of the model consist of two of them:

KGD3 = Using safety equipment such as a jacket when riding a motorcycle helps to keep the air temperature in the body stable

KGD4 = Using safety equipment when riding a motorcycle helps maintain a healthy body

6. Attitude Variable (SKP)

Question indicators that represent this variable in the overall fit of the model consist of two of them:

SKP1 = Using safety equipment when riding a motorcycle is very safe

SKP4 = Using safety equipment while riding a motorcycle is a commendable behavior

7. Subjective Norm Variables (NRS)

Question indicators that represent this variable in the overall fit of the model consist of two of them:

NRS3 = Friends influence me to behave safely while riding a motorcycle

NRS4 = Social environment influences me to behave safely in riding a motorcycle

8. Behavioral Control Variables (KTP)

Question indicators that represent this variable in the overall fit of the model consist of two of them:

KTP1 = I use an SNI helmet when riding a motorcycle even though it's not a traffic order zone

ID card2 = I have the necessary resources to demonstrate safe driving behavior

9. Safe Behavior Intention Variable (IPS)

Question indicators that represent this variable in the overall fit of the model consist of two of them:

IPS2 = My intention from now on is not to ride a motorcycle without wearing one of the safety equipment

IPS3 = I want to use safety equipment more often when riding a motorcycle in the future

10. Safety Behavior Variable (PKS)

Question indicators that represent this variable in the overall fit of the model consist of two of them:

PKS6 = When driving I always obey traffic signs

PKS7 = When riding a motorcycle, I keep my distance from the vehicle in front so that it is easy to stop in an emergency.

Table 3. Standardized regression weights [30]

Track			Estimate	Track			Estimate
KPG	←	KPD	-0.351	IPS	←	SKP	0.376
KPG	←	KRD	0.678	IPS	←	NRS	0.185
KPG	←	EFD	0.415	IPS	←	KTP	-0.086
KGD	←	KPG	0.811	IPS	←	KGD	-0.022
KGD	←	KPD	0.296	PKS	←	EFD	0.148
KGD	←	KRD	-0.366	PKS	←	KRD	0.279
KGD	←	EFD	-0.228	PKS	←	KPD	-0.220
SKP	←	KPG	0.847	PKS	←	IPS	0.459
SKP	←	KGD	0.086	IPS	←	SKP	0.376

Table 4. Square multiple correlation [30]

Variable	Estimate
Perceived Ease of Use (KPG)	0.384
Perceived Usefulness (KGD)	0.465
Attitude (SKP)	0.819
Safe Behavior Intention (IPS)	0.149
Safety Behavior (PKS)	0.277

5. CONCLUSIONS

Based on the findings and discussion in order to answer the formulation and objectives of the study, the conclusions relevant to the results of the analysis are as follows:

1. The structural equation model (SEM) formed from the integration of TAM, TPB, and HBM is 5 equations including [30]:

Structural Equation 1:

$KPG = 0.678 \times KRD) + 0.415 \times EFD - 0.351 \times KPD + 0.616$

Structural Equation 2:

$KGD = 0.811 \times KPG + 0.296 \times KPD - 0.336 \times KRD - 0.228 \times EFD + 0.535$

Structural Equation 3:

$SKP = 0.847 \times KPG + 0.086 \times KGD + 0.181$

Structural Equation 4:

$IPS = 0.376 \times SKP + 0.185 \times NRS - 0.086 \times KTP - 0.022 \times KGD + 0.851$

Structural Equation 5:

$MCC = 0.148 \times EFD + 0.279 \times KRD - 0.22 \times KPD + 0.459 \times IPS + 723$

2. The safety behavior intention variable is the most direct factor influencing the safety behavior of motorcyclists in Jakarta. While the most indirect factor on safety behavior is the attitude of the driver himself.

NOMENCLATURES

1. Acronyms

JABODETABEK: Jakarta, Bogor, Depok, Tange-rang and Bekasi

POLRI KORLANTAS: Korps Lalu Lintas Kepolisian Negara Republik Indonesia / Indonesian National Police Traffic Corps)

TAM: Technology Acceptance Model

TPB: Theory of Planned Behavior

HBM: Health Belief Model

SIM C: Surat Ijin Mengemudi C / Driver License Motorcycle

ACKNOWLEDGEMENTS

This research is fully supported by University of Mercu Buana and University of Kebangsaan, Malaysia as a Joint Research Collaboration Overseas. The authors owe their gratitude to all those people who have made this work possible and because of whom their experience have been one that they will cherish forever.

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BIOGRAPHIES

Nunung Widyaningsih was born in Indonesia on January 4, 1959. She received a degree in Civil Engineering from University of Gadjah Mada, Indonesia in 1987, Postgraduate Diploma Engineering form Institute for Transport Studies, Indonesia in 1995 and the Ph.D. degree from Tarumanagara University, Indonesia in 2013. She is a senior lecturer at the Master of Civil Engineering in Engineering Faculty of Mercu Buana University, Jakarta, Indonesia. From 2006, she presents as corresponding and responsible for this research as well. She is a lecturer in Transportation Engineering for Undergraduate Studies and a Traffic Control Engineering, Transport Modelling and Mathematics for Postgraduate Studies. She is a reviewer in journal of Civil Engineering as Sinta 5 in Department of Civil Engineering and Journal of Sinergi as Sinta 2 for Engineering Faculty of Mercu Buana University (Sinta is Government ranking journal in Indonesia), Indonesia. She is reviewer in Journal of Engineering Research and Sciences as reviewer code JSR00483. She is reviewer in research for young lecturer. She has authored or co-authored of several papers) in the Scopus journals. She is a member of organization of Engineering in Indonesia. Her research interests are transport demand, pavement, transport infrastructure and traffic engineering.

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